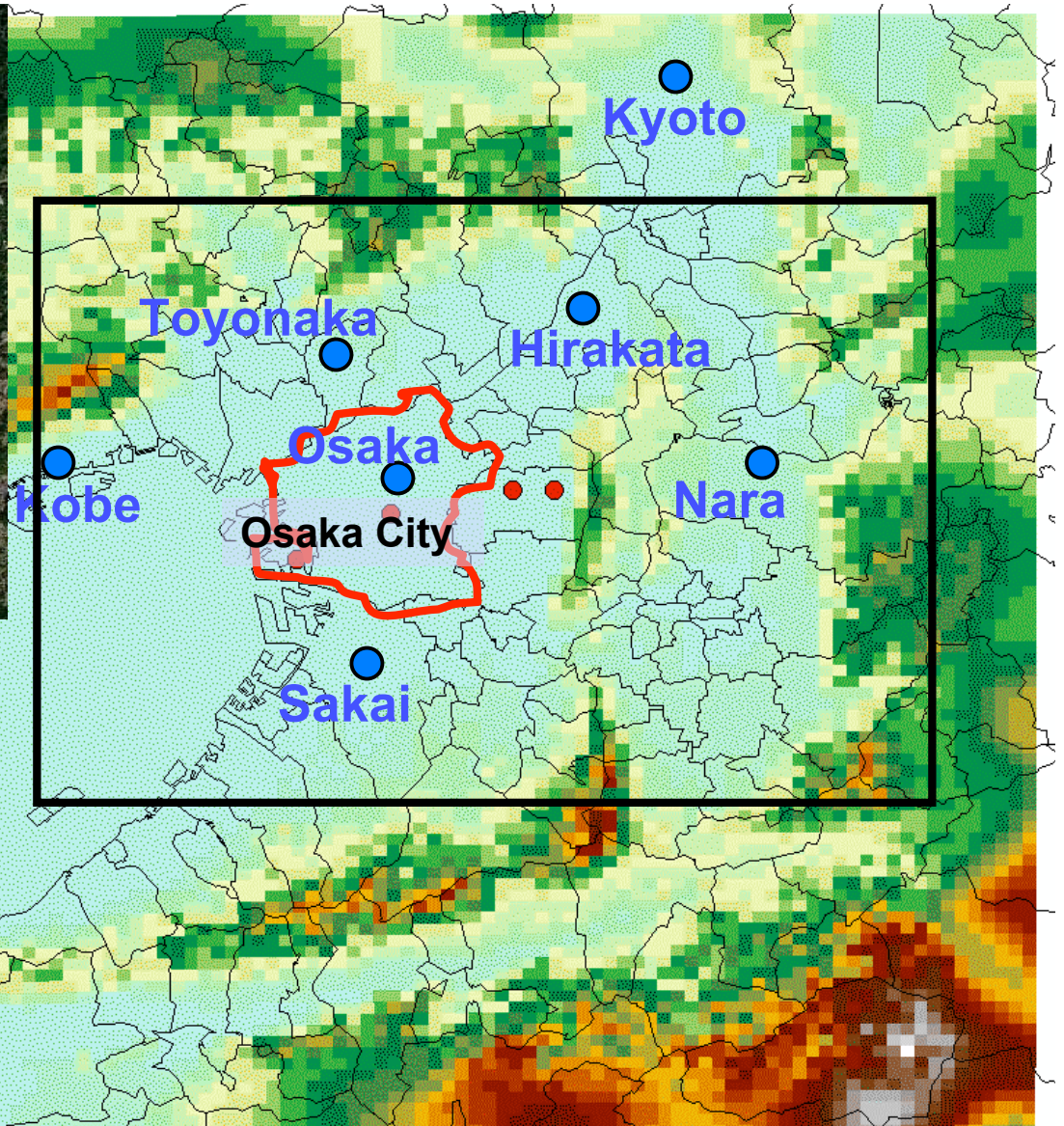




**Second International Conference on Countermeasures to Urban Heat Islands
(SICCUHI) September 21-23, 2009 in Berkeley, California**

The Mitigation of UHI Intensity by the Improvement of Land Use Plan in the Urban Central Area - Application to Osaka City, Japan -

Masakazu MORIYAMA, Kobe University, Kobe, Japan
Takahiro TANAKA, Hiroshima University, Hiroshima, Japan
Motofusa IWASAKI, Kobe University, Kobe, Japan



Location of Osaka Region

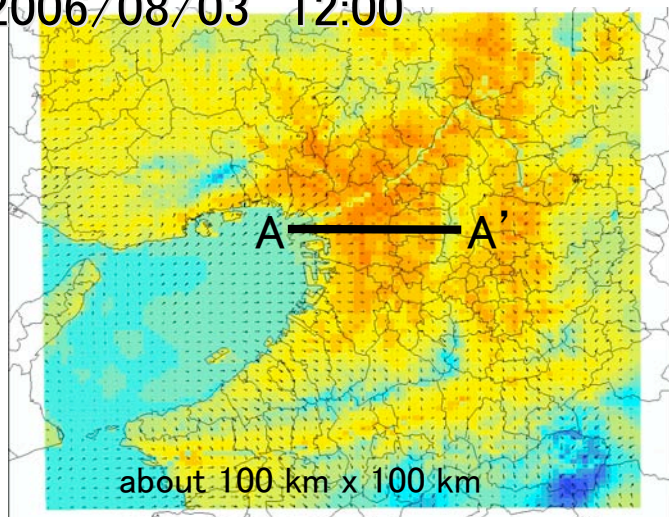


The population of Osaka City is 2.65 million and the city area is 222.3 km². The population density is very high. The Osaka area is among the hottest areas of Japan

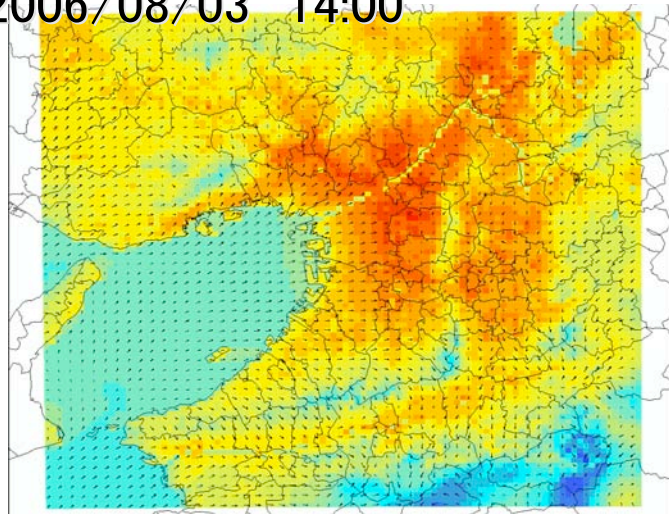
Heat Island Structure (calculated by WRF)

Horizontal and Vertical Profile of Air temperature (2m high) and Wind (10m high) (maximum time, sea breeze is stronger and blow to inland. Cooling effect of sea breeze)

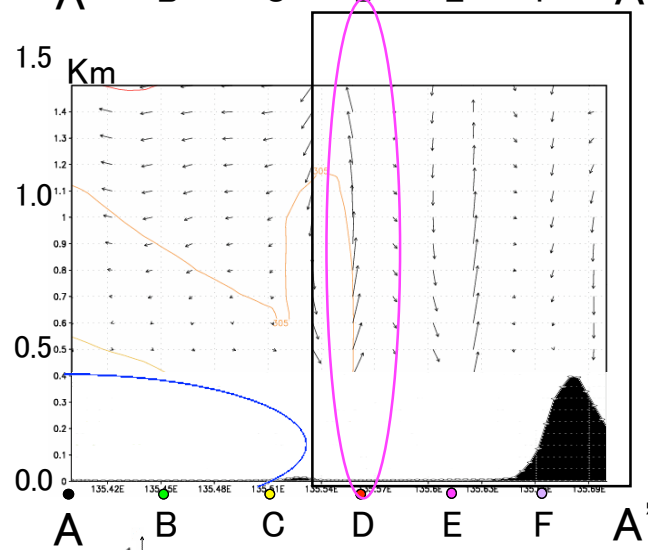
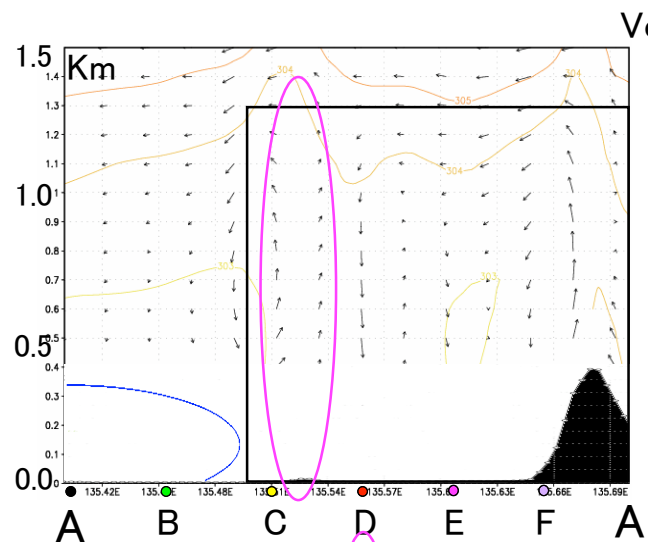
2006/08/03 12:00



2006/08/03 14:00



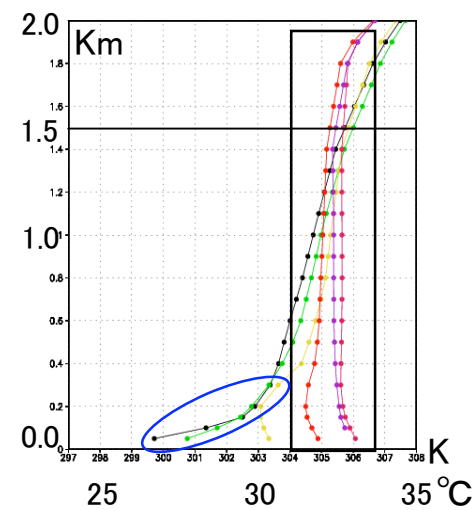
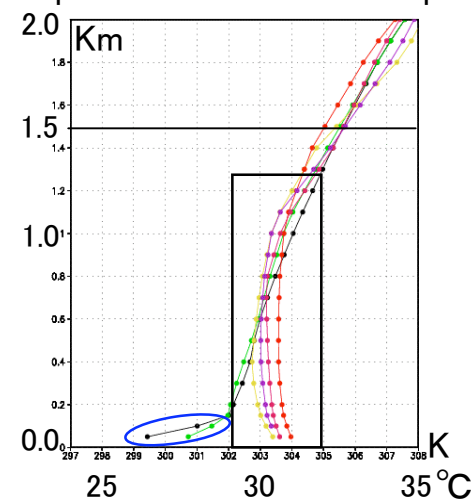
19°C以下 37°C以下 (地上2m)
0m/s 12m/s以上 (地上10m)



1
10 (m/s)
Z方向はX方向の10倍

コンター(K): 温位

Vertical profile of Potential Temp

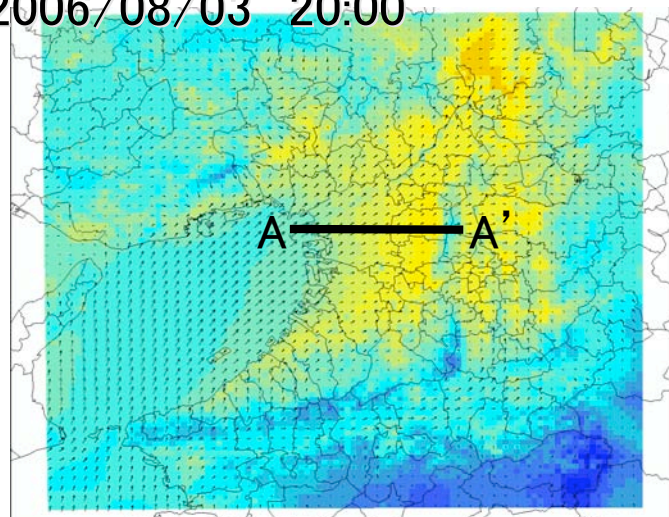


3

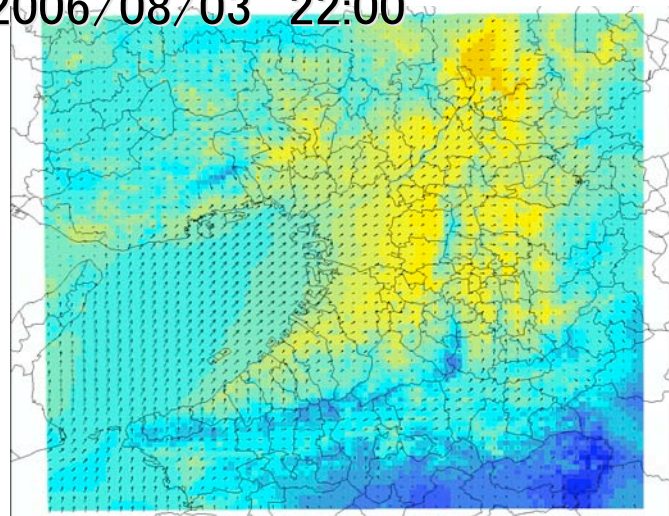
Heat Island Structure (calculated by WRF)

Horizontal and Vertical Profile of Air temperature (2m high) and Wind (10m high) (evening, sea breeze reached deepest area over mountain. atmosphere begin to stable)

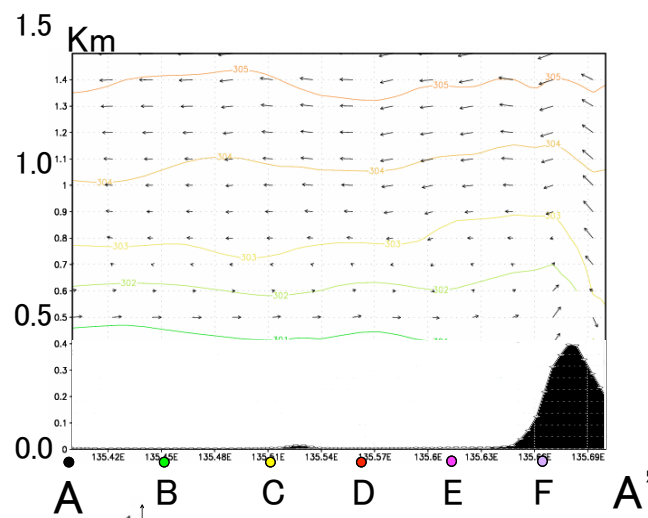
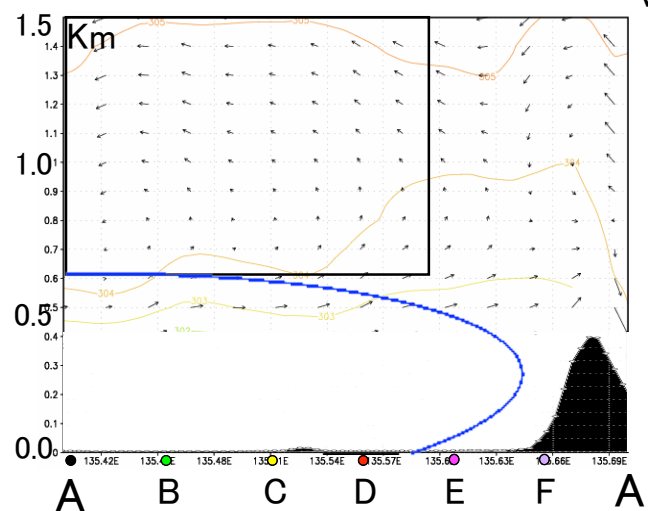
2006/08/03 20:00



2006/08/03 22:00



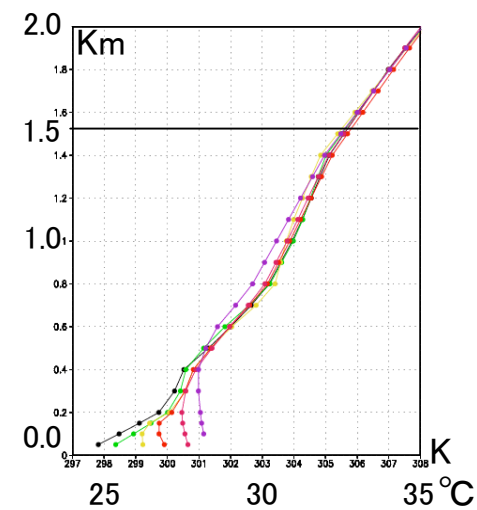
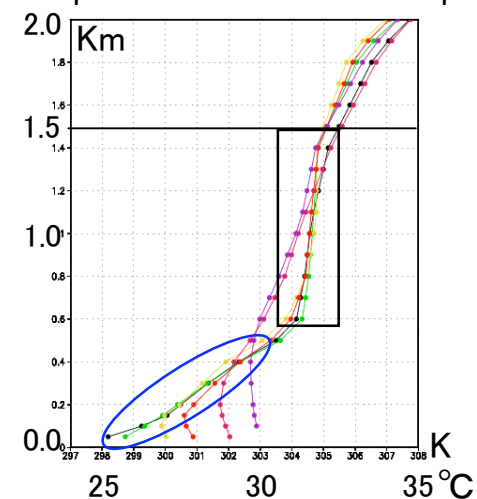
19°C以下 37°C以下 (地上2m)
0m/s 12m/s以上 (地上10m)



1
10 (m/s)
Z方向はX方向の10倍

コンター(K): 温位

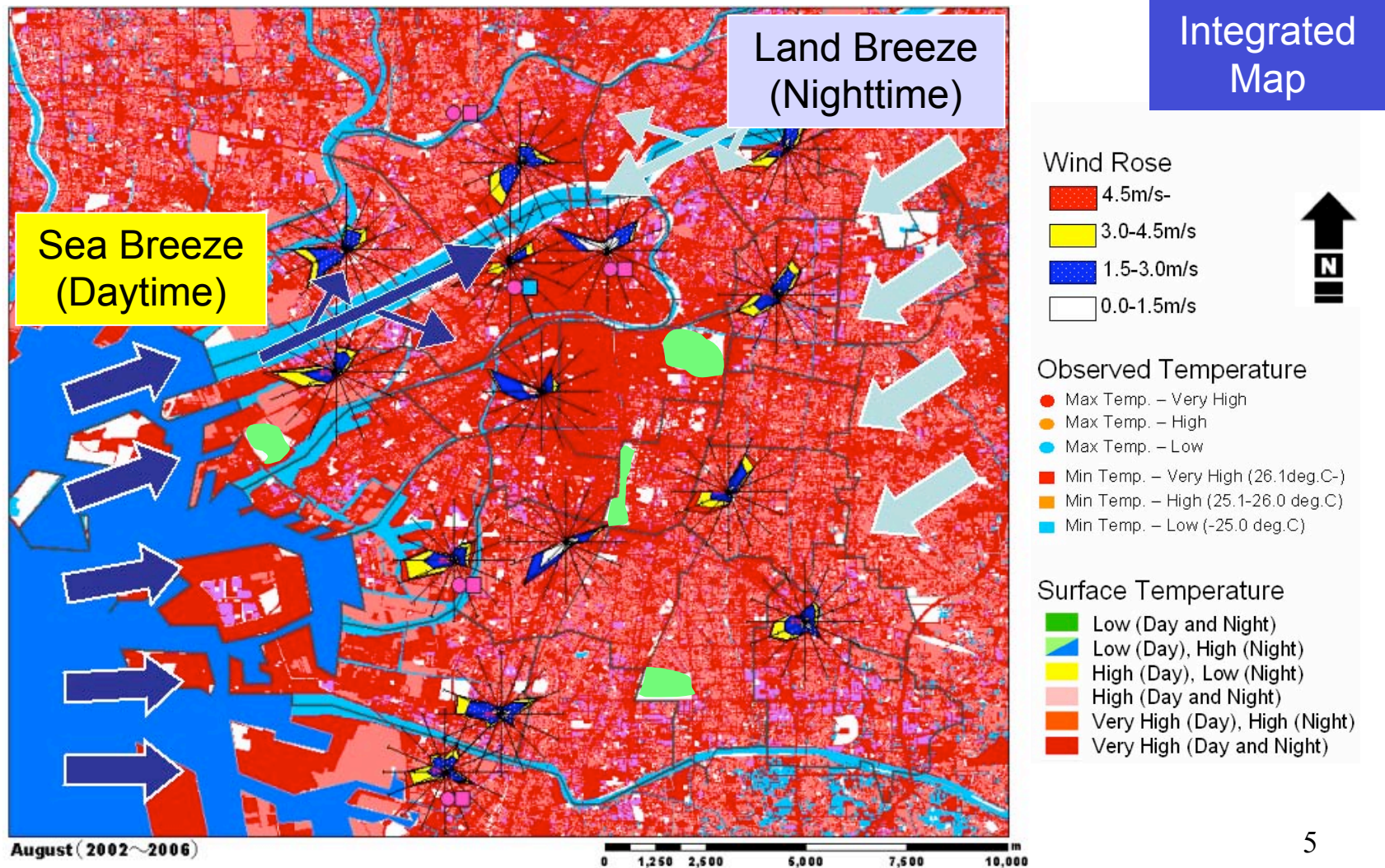
Vertical profile of Potential Temp



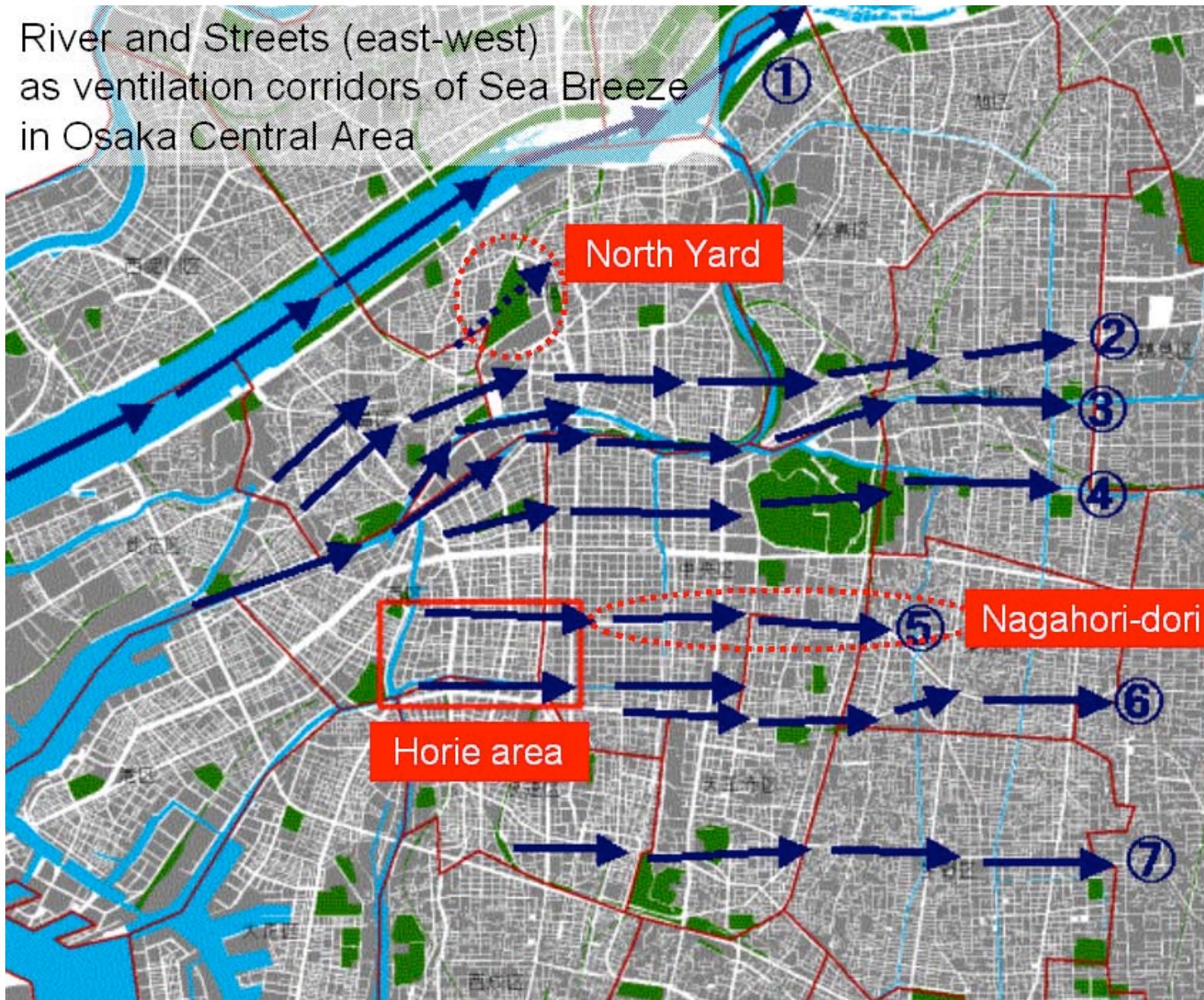
4

Climate Analysis Map for Planning In Osaka

The earth surface of Osaka City is covered by dense built-up area. In daytime, sea breeze blows, and in nighttime, weak land breeze blows from the inland.



River and Streets (east-west)
as ventilation corridors of Sea Breeze
in Osaka Central Area



大阪の風の道と
しての河川と通
りとおープンス
ペース

- ①淀川
- ②国道2号—国
道1号—8号
- ③安治川—堂
島川—土佐堀
川—大川—寝
屋川
- ④本町通、靱公
園、大阪城公園
- ⑤長堀通
- ⑥南北掘江地
区・道頓堀川・
千日前通—30
8号—24号
- ⑦天王寺公園、
四天王寺、大阪
八尾線
- ⑧松虫通
- ⑨179号—5号
- ⑩479号、住之
江公園、住吉神
社、長居公園
- ⑪大和川

Plan of „Kaze-no-Michi” (ventilation lane)

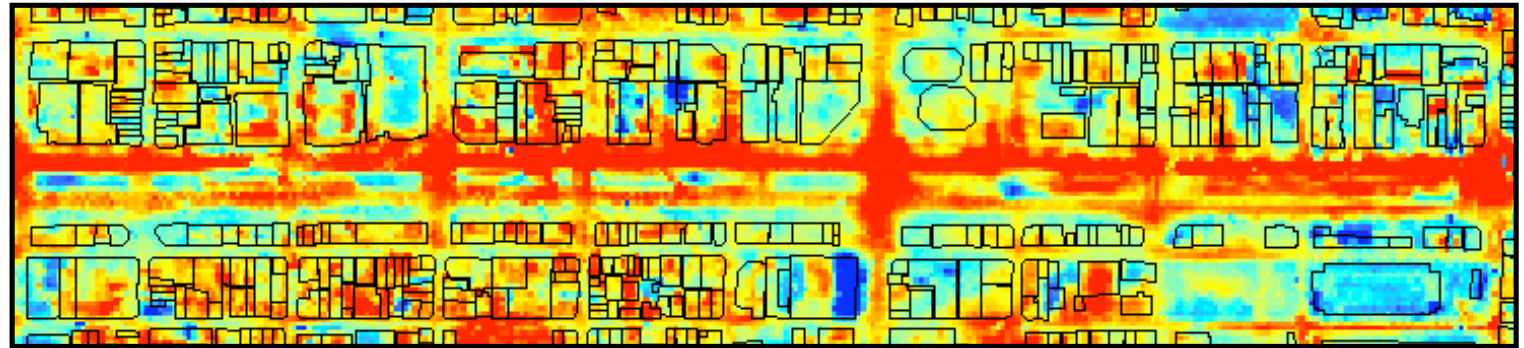
Surface Temperature of Nagahori-dori

(provided by Pasco)

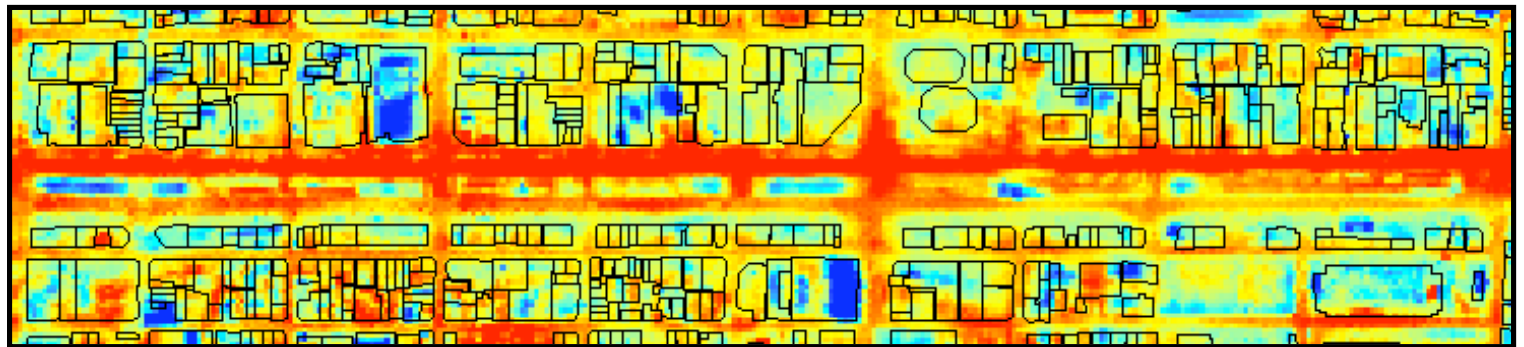
Aerial
photo



evening
(2003/09/11
16:48)



night
(2003/09/14
23:40)



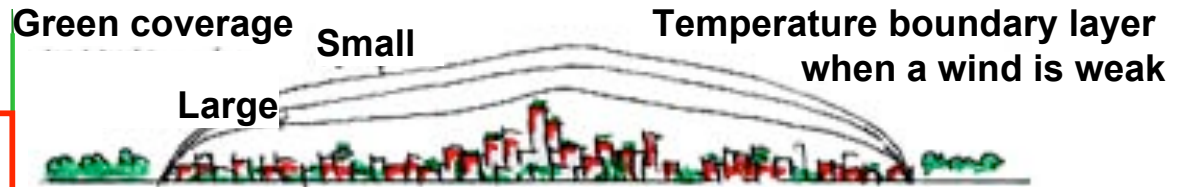
The north-side lane of the road has very high temperatures, because the road is wide and has no street trees. There is almost no shade. The improvement of road condition on thermal environment is needed.

Concept of Countermeasures to Urban Heat Island

Building Scale

Three basic factors to UHI measures:

- 1) Improvement of Land Cover
- 2) Reduction of Anthropogenic Heat
- 3) The utilization of the wind caused by local wind circulation



1. Reduction of UHI Intensity by means of scattering green

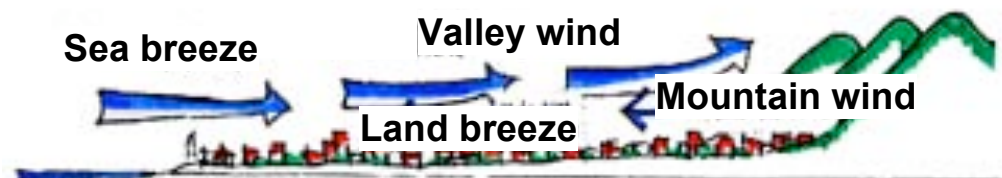
Urban Scale



2. Divide of UHI Boundary Layer by means of green zone

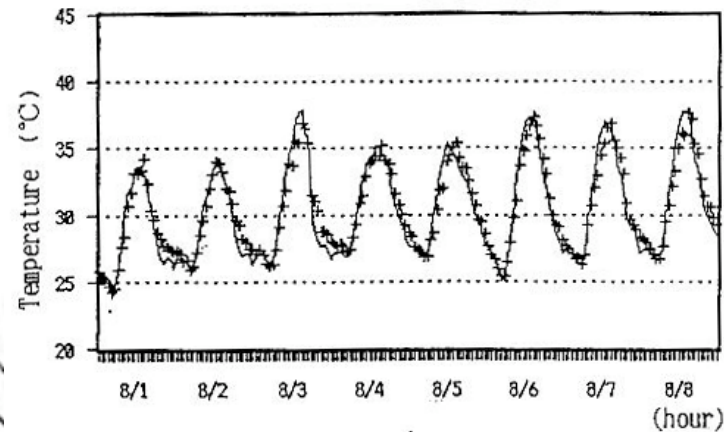
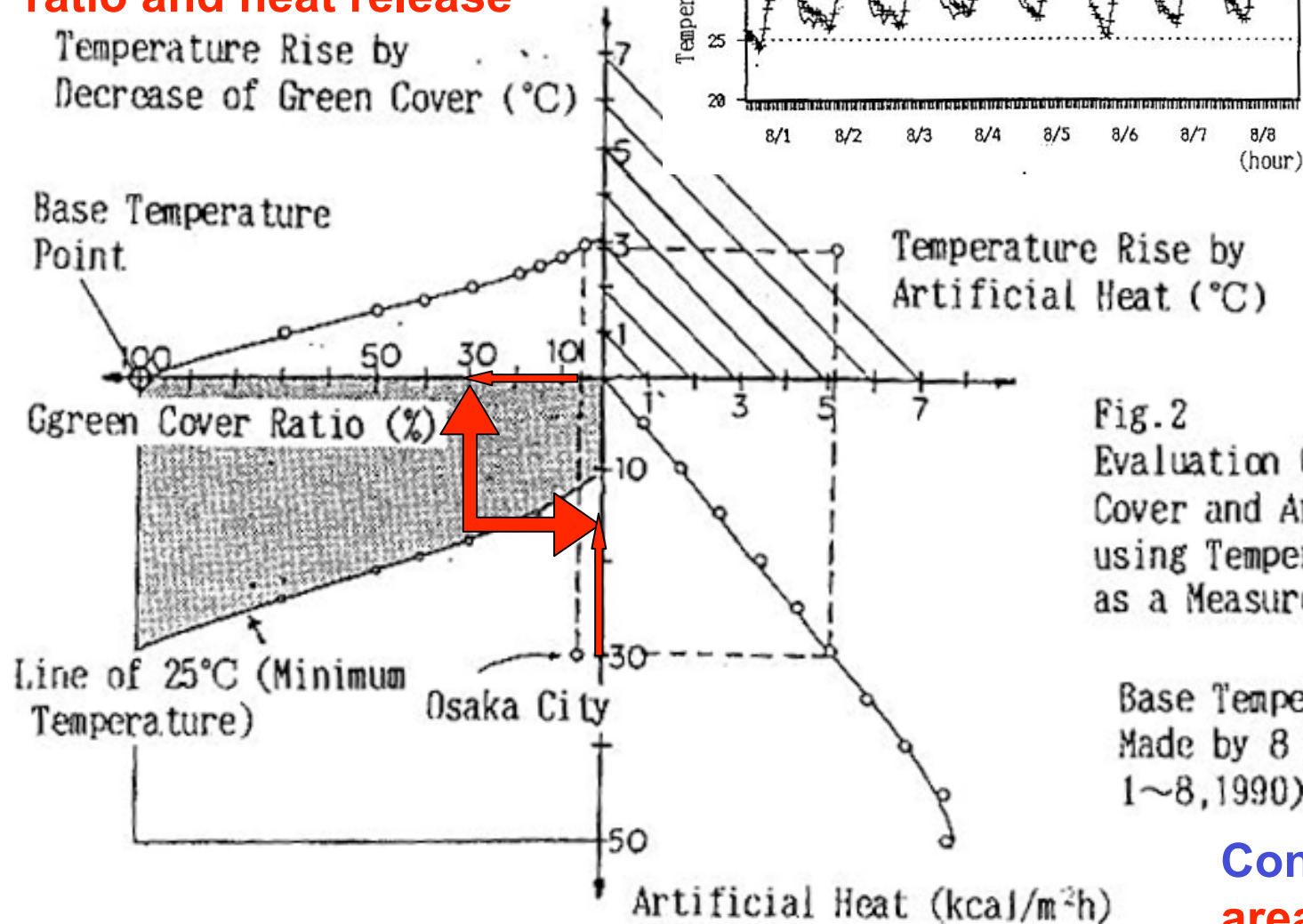


3. Disappearance of UHI Intensity by means of high rise buildings



4. Reduction of UHI Intensity by means of the wind caused by "Local Wind Circulation System"

Evaluation Graph of minimum air temperature rise depend on green area ratio and heat release



The calculation condition is fine summer, one week data.

Fig.1
Comparison of Calculation Result and Observed Value
---: Calculation Result
+: Observed Value

One dimensional heat budget model was used for the simulation.

Fig.2
Evaluation Chart of Urban Green Cover and Artificial Heat using Temperature Rise as a Measure of Evaluation

Base Temperature is 19.8°C,
Made by 8 Days Data (August 1~8, 1990) in Osaka.

Conclusion: Green area ratio in Osaka central area needs at least about 30%.

T.Takahashi, M. Moriyama: Control Method of Urban Thermal Environment, Summary of technical papers of Annual Meeting Architectural Institute of Japan. D, Environmental Engineering, 1992, 1109-1110 (in Japanese)

Image of new land-use plan for Compact Eco-city

The policy of plan is based on the current urban problems in Japanese cities to be solved under the view points of Safety and Symbiosis

- 1) Increasing green spaces and restoring water front spaces inside central city area for amenity and climate control
 - preparing green spaces “30% of city area”
- 2) preparing good public transportation systems using existing underground train system and new transportation system for comfortable transportation system and pedestrian spaces
- 3) Preparing compact infrastructure system, such as water, energy and waste for conserving resources and for protecting pollutions, partly to concentrate mechanical services and to promote common utilization for decreasing environmental loads

How to Increase Green Space to 30%

How to compactify central urban area

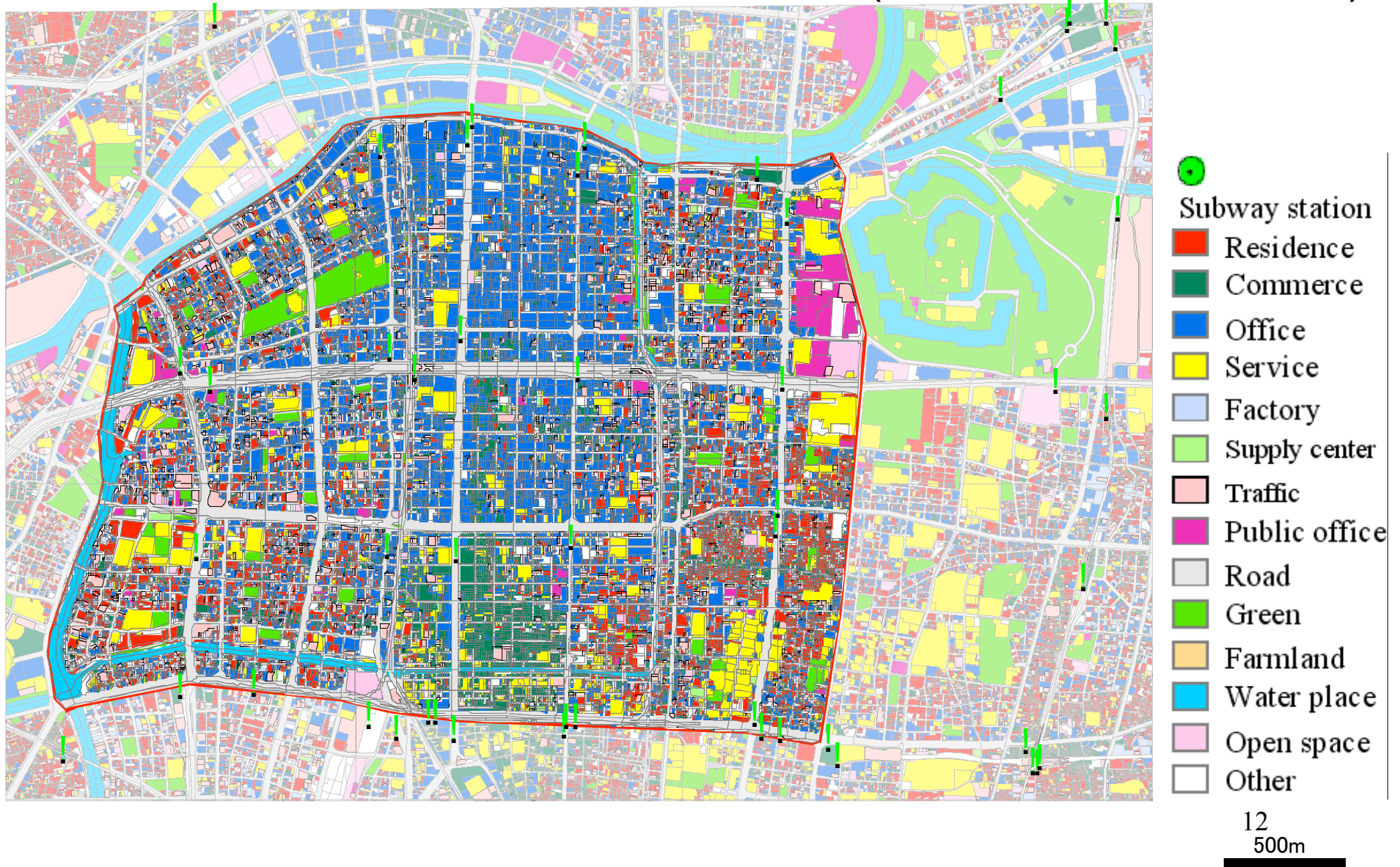
The policy of new land use plan is as follows.

- 1) Making urban core zone (high-rise building zone) around the subway (junction) station.
- 2) Dividing all objective areas into 3 type land use categories
 - (1) Urban core zone (high-rise building zone) mainly for office, commercial and public buildings
 - (2) Residential zone (low-rise building zone) mainly for houses, residences
 - (3) Green zone (10-30%) for Kaze-no-michi (Ventilation lane), recreation, ecosystem and historical buildings conservation
- 3) Green zones should be located far from the stations

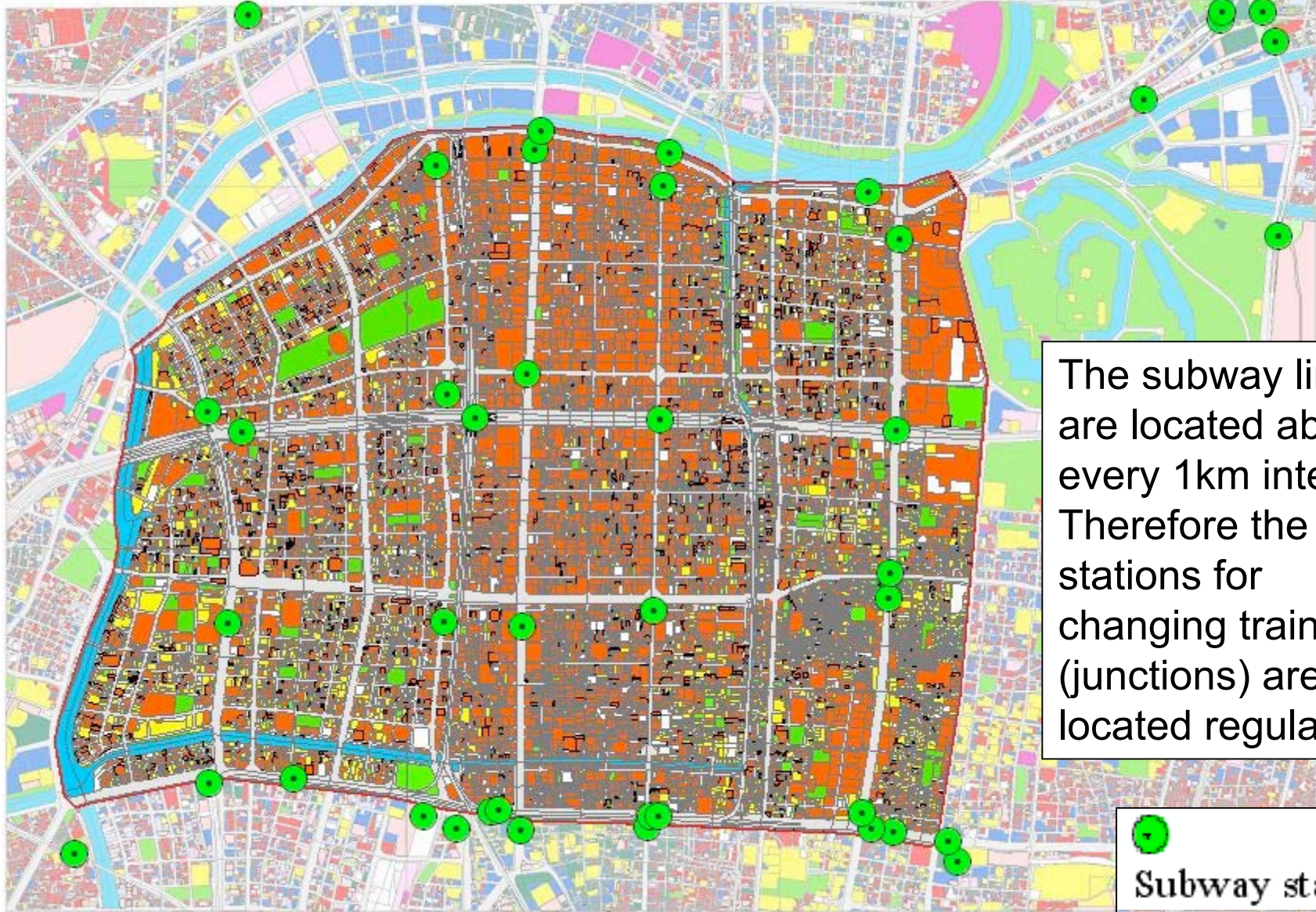
Present Land Use

based on **parcel unit**


The area ratio of green spaces are
about 4.9% (about 3km x 3km area)



3 type land use  Core zone  Residential zone  Green zone



The subway lines are located about every 1km intervals. Therefore the stations for changing trains (junctions) are located regularly.

 Subway station

Present Land Use

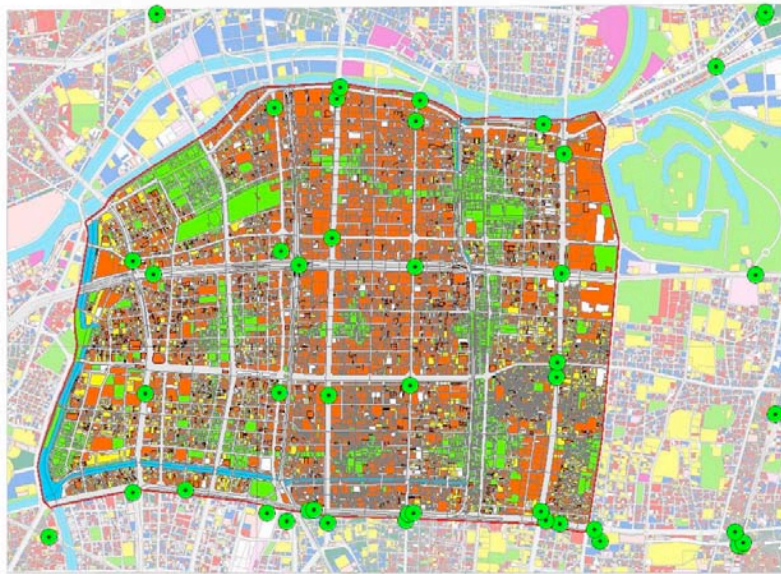
500m

based on **parcel unit**
Green spaces - **4.9%**

Present **Green 4.9%**



Green 10%



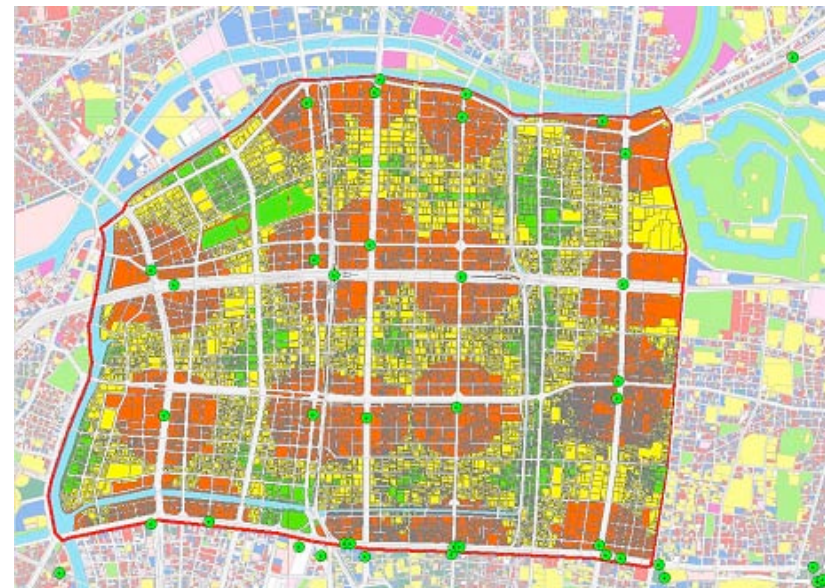
500m

Green zones, located far from the stations

The succession of land use pattern

- Core zone
- Residential zone
- Green zone

Future Land Use Plan
to compactify urban area



1 / 1

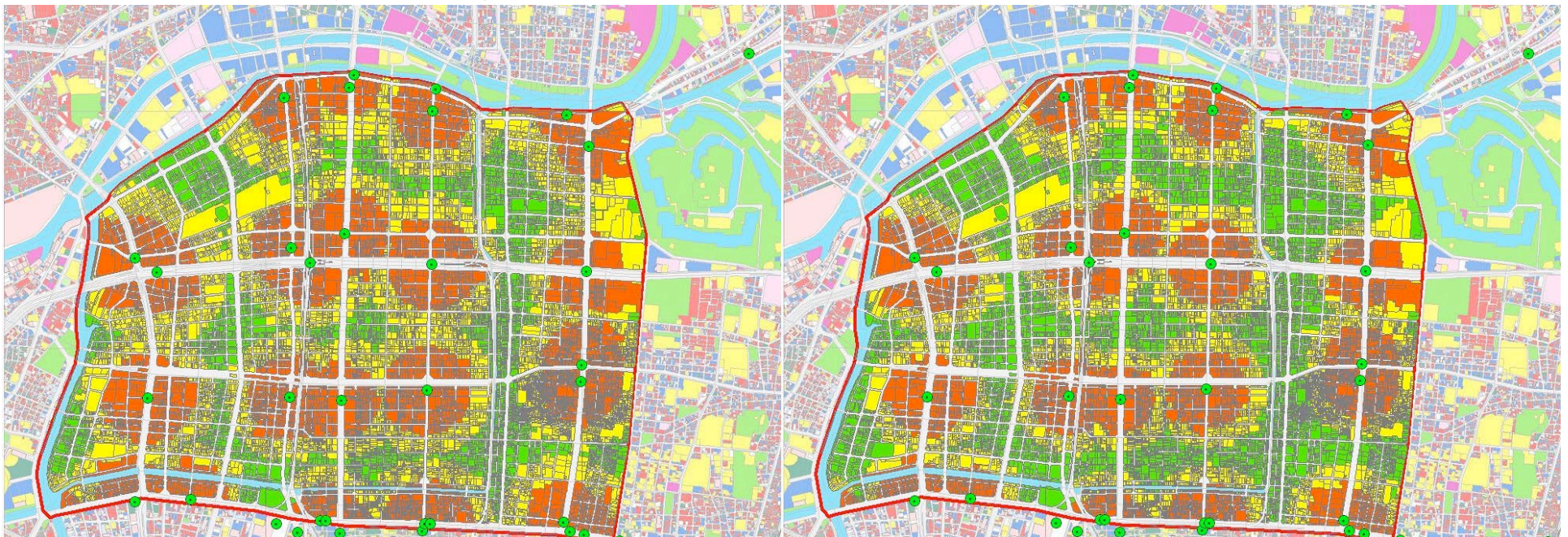
Case1 **Green:10%**, **Core:45%**, **Residential:45%**

Future Land Use Plan based on parcel unit

- Core zone
- Residential zone
- Green zone

500m

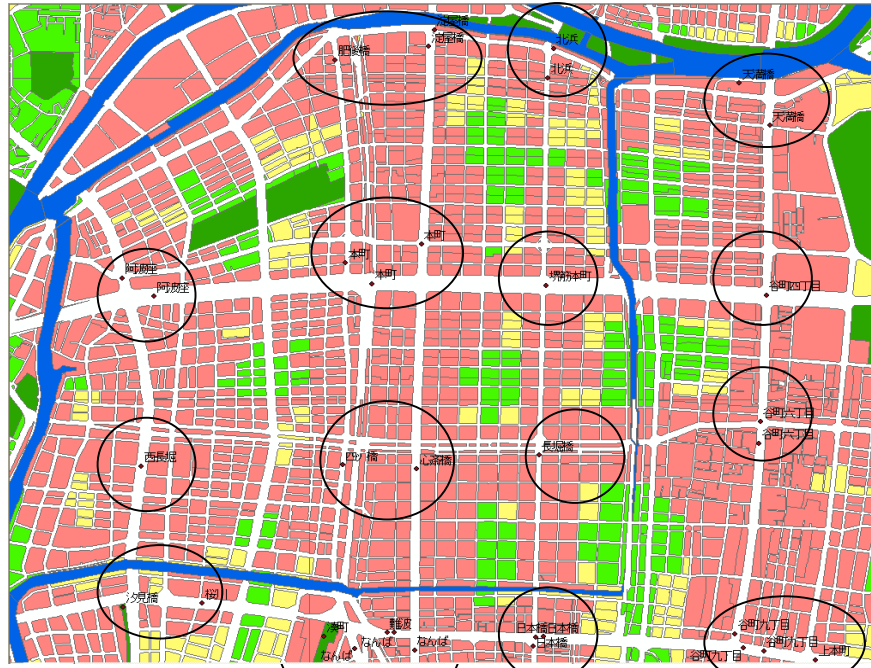
Case1 **Green:10%, Core:45, Residential:45**



Case 2 **Green:20%, Core:40, Residential :40**

Case 3 **Green:30%, Core:35, Residential :35**

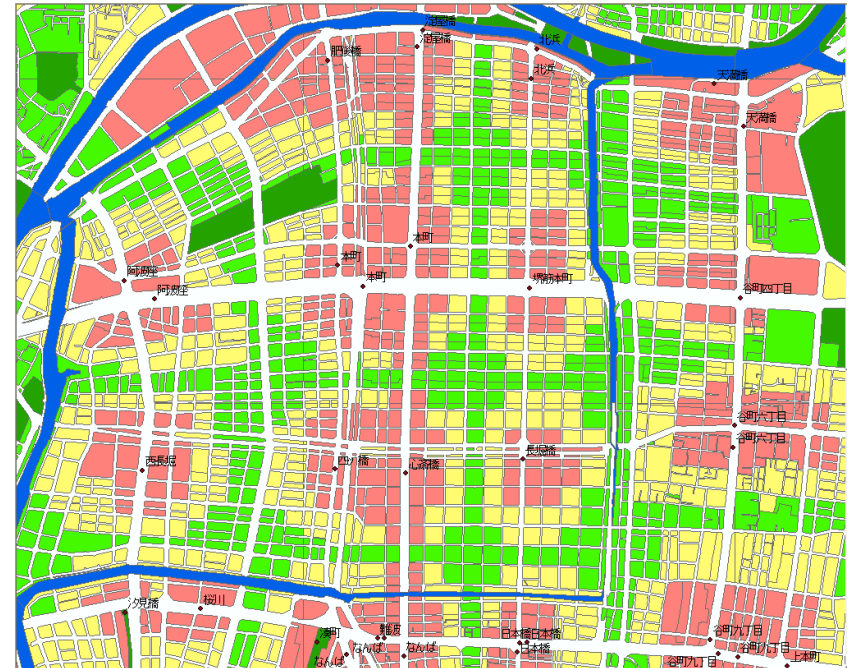
Future Land Use Plan by **Grid Model** based on **street blocks**



Green Area 10% Case
(about 3km x 3km area)



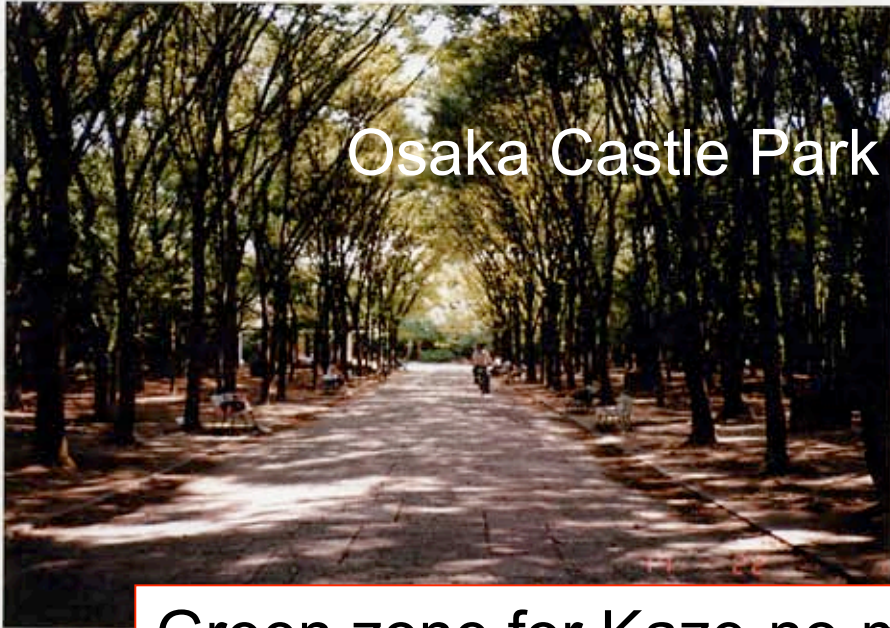
500m



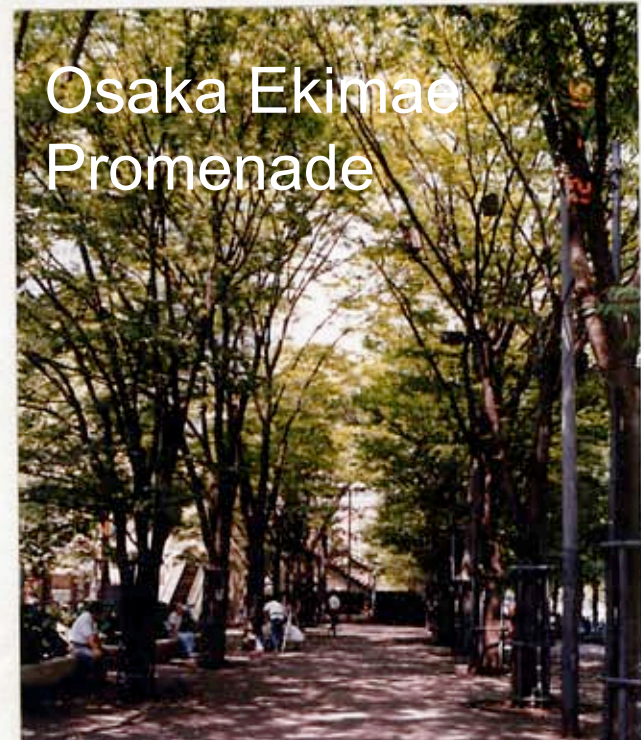
Green Area 30% Case
Almost equally distribute the existing
street blocks to green zone, high-rise
zone and low-rise zone

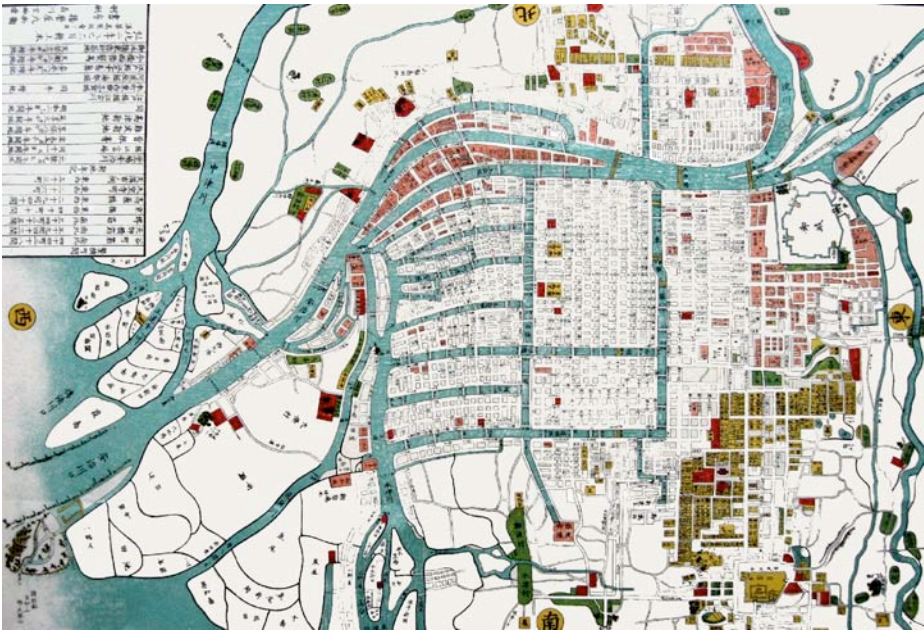
The roads in Osaka central area consist of about 86m grids
(**Street block** size).

Image of Green zone

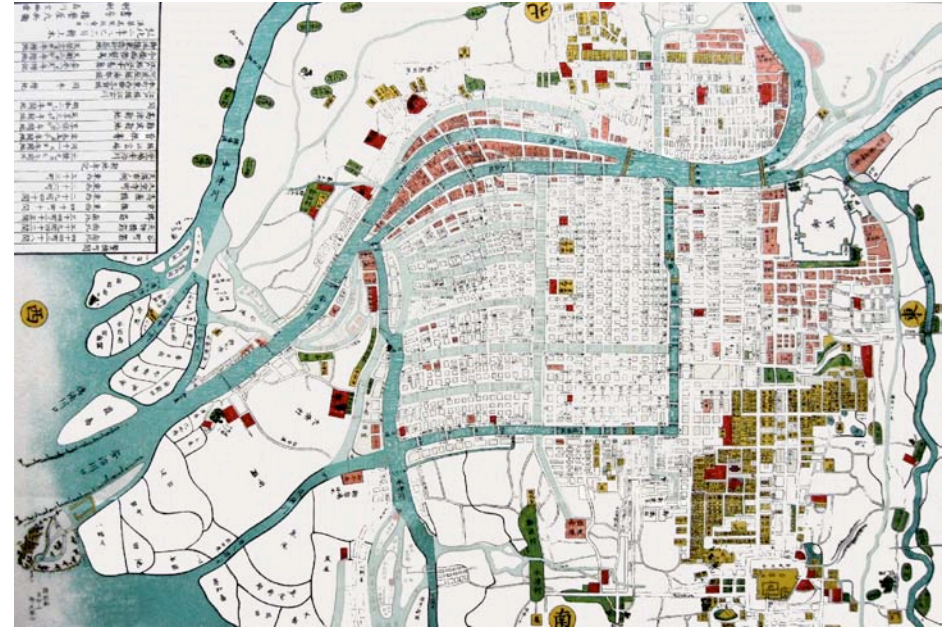


Green zone for Kaze-no-michi
(Ventilation lane), recreation,
ecosystem and historical
buildings conservation





Osaka in 1845, there were many moats, rivers and bridges.



Now, a lot of moats and rivers are lost. They were reclaimed.

Historical area and historical buildings should be preserved. Partly in green, converting to a museum, restaurant, and so on.

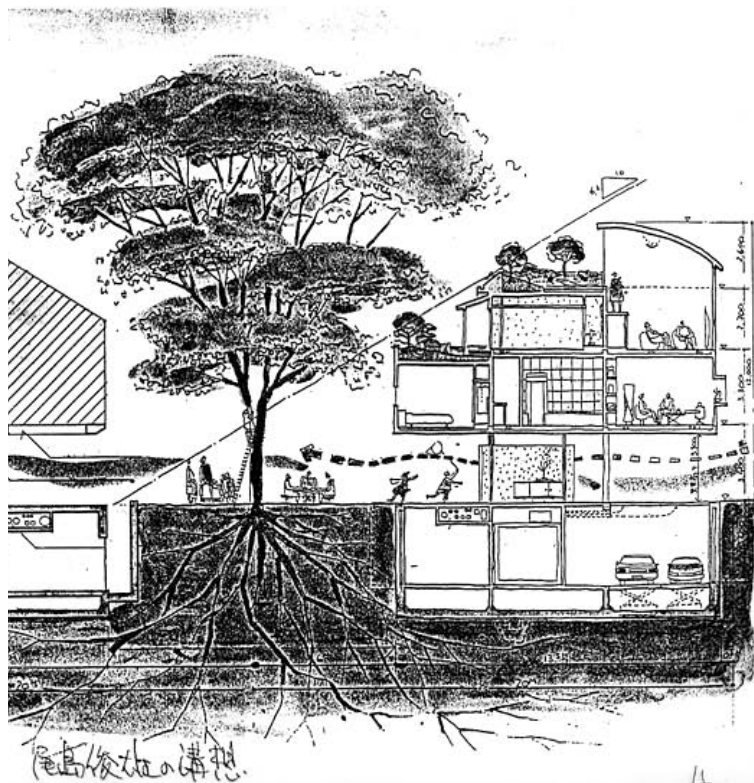
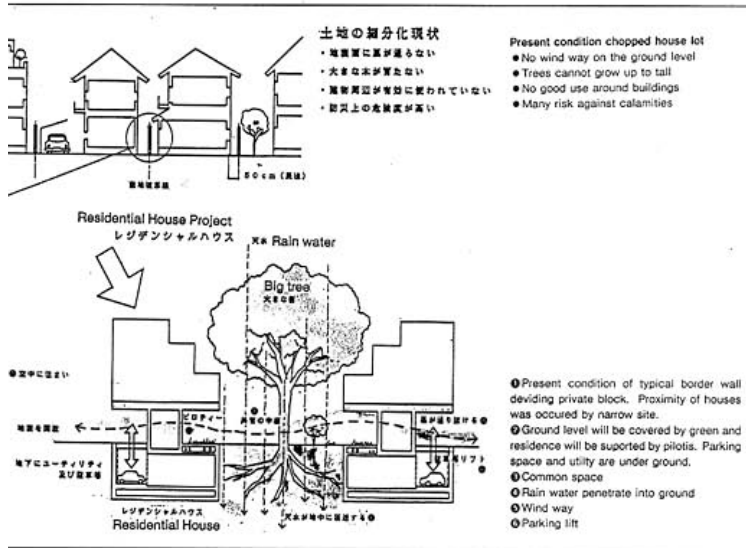
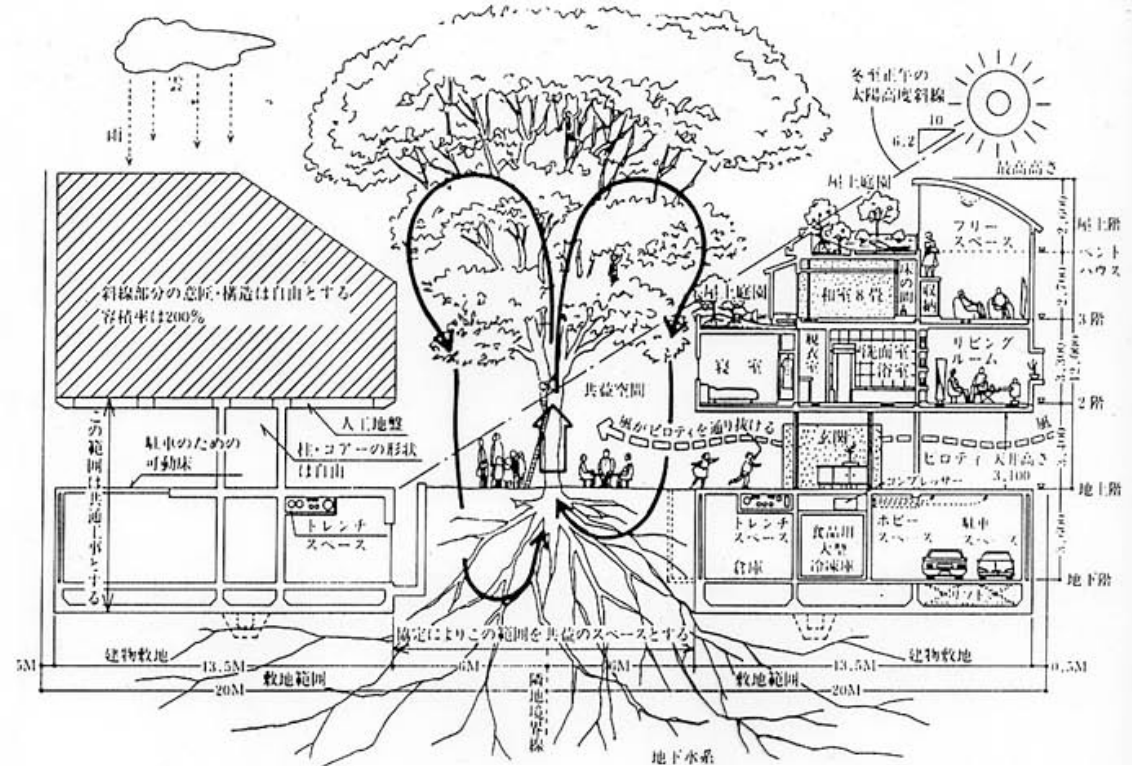


Image of Residential Zone Low-rise area



(from T. Ojima, Waseda University)

The residential zone is a low-rise area for houses. The residential houses are located around the core zone with plentiful green.



Osaka Business Park

Image of Core zone
High-Rise Building Area
(Office, Commercial, Public Buildings)



For the viewpoint of wind flow, high-rise buildings at the central area would be more desirable than the type of courtyard that is popular in Europe.

Summary of Compact Eco-city Plan

The policy of plan is based on the current urban problems in Japanese cities to be solved.

1) Restoration of green and water front area - Formation of “Kaze-no-michi” (ventilation lane)

- For recreation, natural environmental preservation and countermeasures to Urban Heat Island
- Green spaces would be needed “30% of urban area”

2) Breakaway from cars – to good public transportation systems

- using existing underground train and new transportation system for comfortable transportation system and pedestrian spaces

3) Completing the urban infrastructure to the compact systems, water, energy and wastes - supply and management system

- For conserving resources and for protecting pollutions
- Partly to integrate mechanical services and to promote common utilization for decreasing environmental loads

Future Works

We need **the forecast assessment** as follows.

- Improvement effects of Urban Climate
(Air Temperature , wind ventilation)
- Adaptation to Global warming
- Effects of Compactification
 - > Energy conservation (buildings, cars)
 - > Reduction of CO₂ exhaust (cars, buildings, green)
- Improvement effects of landscape, recreation spaces, disaster damage and so on.

A method for creating green and waterfront spaces (Future work)

- **Land Readjustment Program** for creating green blocks
 - > adjusting the floor area to each building use

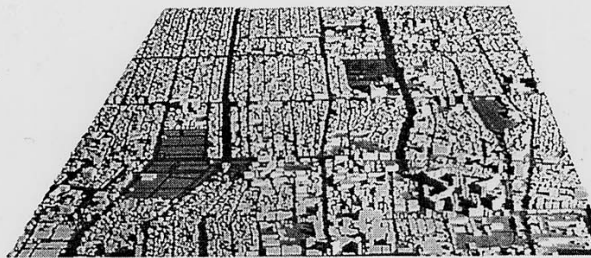


図0-1 下町現況模型

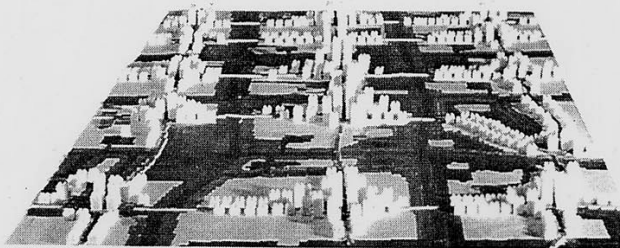


図0-2 下町将来模型

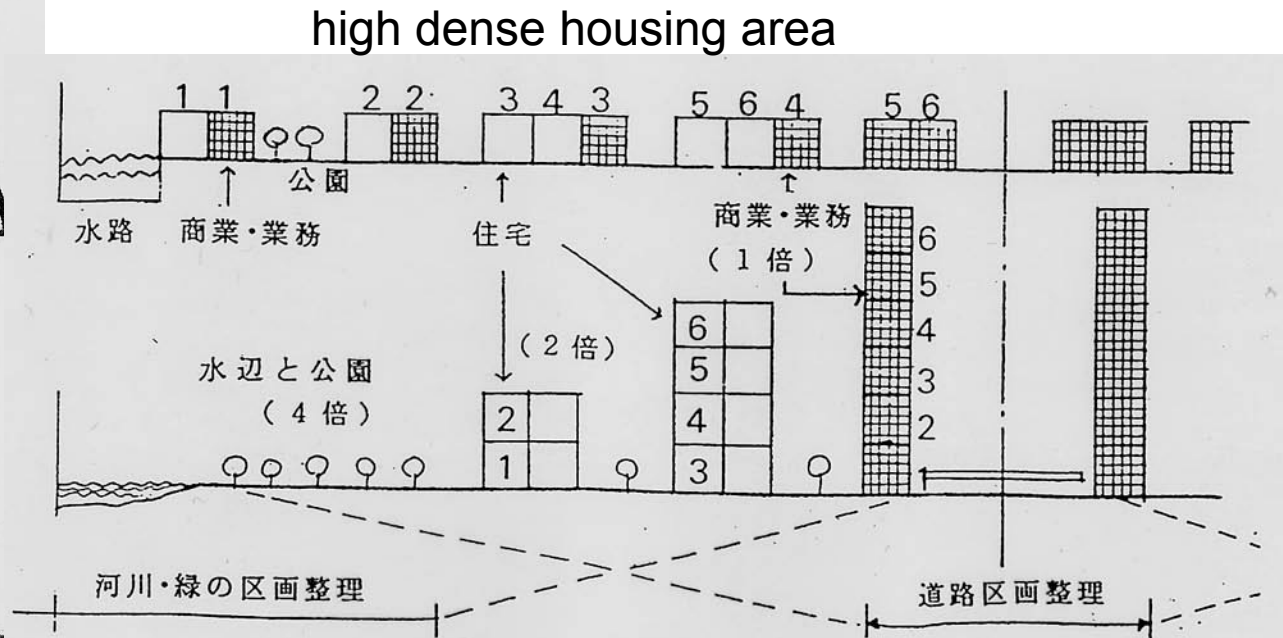
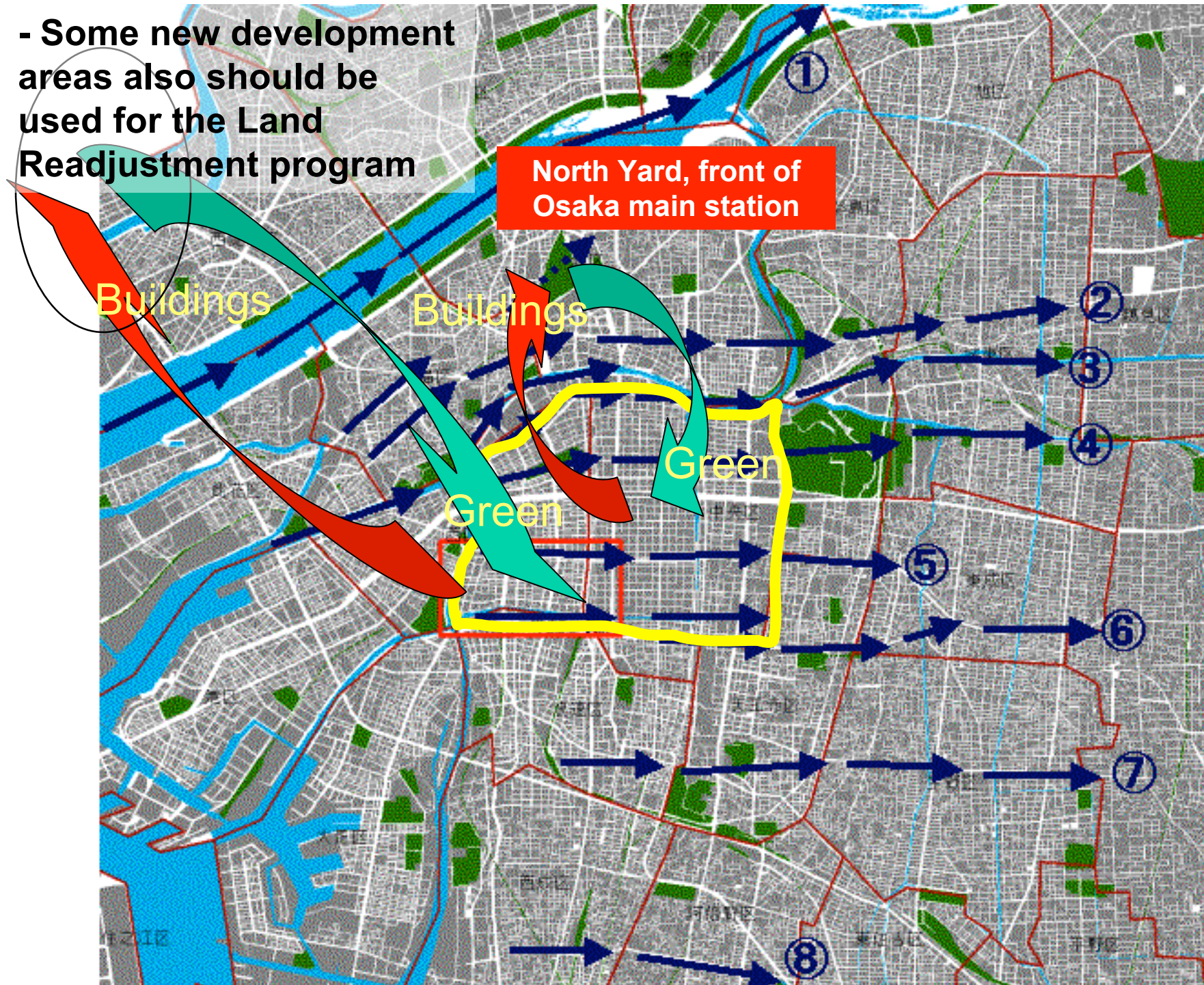


図0-3 陸路と水路の区画整理案

Image of Land Readjustment Program to create green and waterfront spaces
(from T. Ojima, Waseda University)

- Some new development areas also should be used for the Land Readjustment program



Thank you very much for your attention



Residential

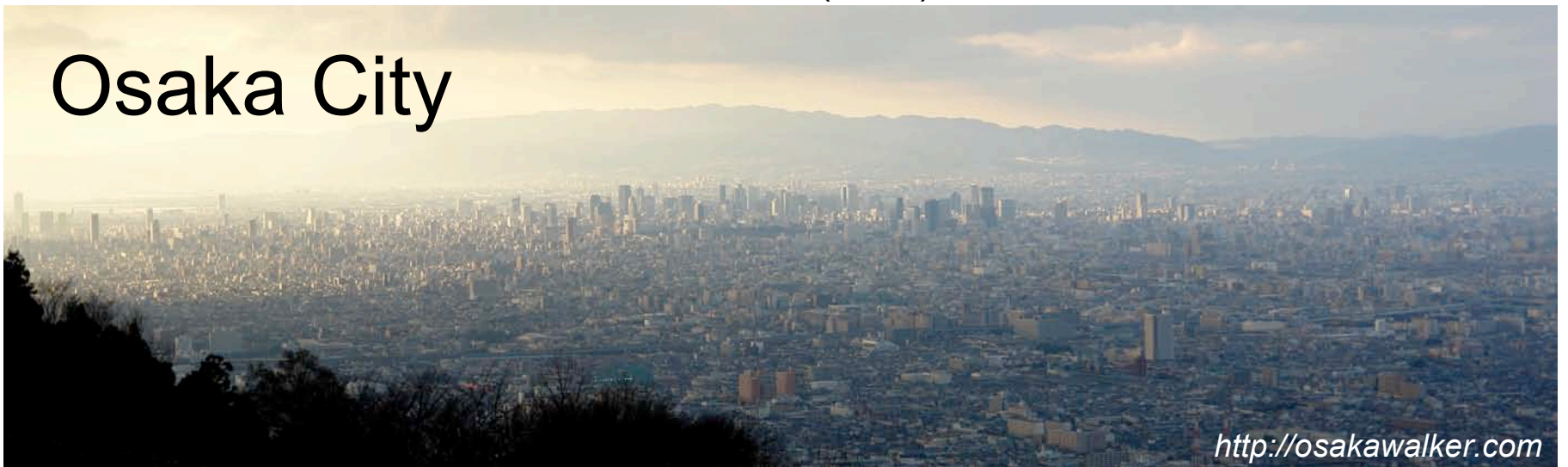


Osaka Castle Park &
Business District (OBP)



Commercial

Osaka City



<http://osakawalker.com>